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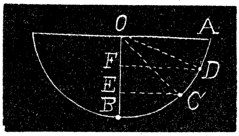
the string would be horizontal. But on its upward path it meets an inelastic particle mass m' and the height to which it rises is diminished by $1/p$th of what it would have risen. Find m', and the tensions of the string just after collision and at the greatest height of the particle.

Solution by G. B. M. ZERR, A. M., Ph.D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.



Let B be the point of projection of particle mass m; C, the position of m' supposed at rest; D, the point at which m stops after impact with m'. Let $\angle COB=\theta$, $BO=a$.. Then $OF=a/p$, $FB=a(p-1)/p$, $OE=a\cos\theta$. Velocity of projection$=\sqrt{(2ga)}$, velocity of m at C at moment of impact$=\sqrt{(2ga\cos\theta)}$.

$\therefore m\sqrt{(2ga\cos\theta)}=v'(m+m')$.

But $v'=\sqrt{(2g.FE)}=\sqrt{[(2ga/p)(p\cos\theta-1)}$.

$\therefore m\sqrt{(2ga\cos\theta)}=(m+m')\sqrt{[(2ga/p)(p\cos\theta-1)}$.

$$\therefore m'=\frac{m\{\sqrt{[\cos\theta]}-\sqrt{[(p\cos\theta-1)/p]}\}}{\sqrt{[(p\cos\theta-1)/p]}}.$$

Let $(m+m')g=W$. The tension is composed of the tension due to acceleration imparted by the central force plus the tension due to gravity. Let $T=$ tension just after impact, $t=$tension at highest point.

$$\text{Then } T=\frac{Wv'^2}{ga}+W\cos\theta=(2W/p)(p\cos\theta-1)+W\cos\theta=3W\cos\theta-2W/p.$$

Since velocity is zero at D, $t=W\cos DOB=W/p$. $\therefore t=W/p$.

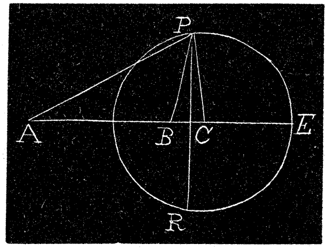
As m' is inelastic, it is supposed that m' coalesces with m.

148. Proposed by G. H. HARVILL, A. M., Malakoff, Texas.

Show that a law of density for points in space may be assumed such that the joint mass of any two points which are *electrical images* of each other in respect to a given sphere may be constant, and that their centers of gravity should lie on the surface of the sphere.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Let A, B be the electrical images, a=radius of sphere, C its center, $AC=x$, $BC=y$. Let e=charge of electricity situated at A; and let the sphere be insulated and have a charge $-(ea^3/x^3)$. Let PR be the line of no electrification. Let m=mass of each point on surface of sphere; u =mass of point at A; v=mass of point at B; $\angle BAP=\theta$. Now $AP=AC$, $BP=PC$ (since PR is line of no electrification). Also



$u+v=2m....(1)$,

$u(x-a)=v(a-y)....(2)$.

From triangles ACP and ABP we have, since $AP=AC=x$, $BP=PC=a$,

$$\cos\theta=\frac{2x^2-a^2}{2x^2}=\frac{x^2+(x-y)^2-a^2}{2x(x-y)}.$$

$\therefore x=a^2/y$. Let $y=a/n$. $\therefore x=an=n^2y$. From (1) and (2),

$$u=\frac{2m}{1+n},\quad v=\frac{2mn}{1+n},\quad u=\frac{v}{n}.$$

Hence, the law: The distance, from the center of the sphere of the point without varies as the square of the distance of the point within from the center of the sphere. The mass of the point without varies directly as the mass of the point within and inversely as the distance from the center.

DIOPHANTINE ANALYSIS.

103. Proposed by **HARRY S. VANDIVER**, Bala, Pa.

Find some solutions of $x^3+ay^3=z^3$ (for x, y, and z) and show that there is an infinite number of solutions corresponding to each integral value of a.

Solution by **L. C. WALKER**, A. M., Graduate Student, Leland Stanford Jr. University, Cal.

For generality we may write

$$x^3+mx^2y+nxy^2+ay^3=x^2\ldots.(1).$$

Let us consider the following products.

$$(u+\alpha v+\alpha^2w)(u+\beta v+\beta^2w)(u+\gamma v+\gamma^2w)\ldots.(2),\text{ and}$$
$$(u'+\alpha v'+\alpha^2w')(u'+\beta v'+\beta^2w')(u'+\gamma v'+\gamma^2w')\ldots.(3),$$

where α, β, γ are the roots of $\theta^3-m\theta^2+n\theta-a=0\ldots.(4)$,

Then $\Sigma\alpha=m$, $\Sigma\alpha\beta=n$, and $\alpha\beta\gamma=a$. Since α is a root of (4), we have

$$\alpha^3=m\alpha^2-n\alpha+a,\text{ or}$$
$$\alpha^4=m\alpha^3-n\alpha^2+a\alpha=(m^2-n)\alpha^2-(mn-a)\alpha+am\ldots.(5).$$

Hence the product of the first factor in (2) by the first factor in (3), is $U+\alpha V+\alpha^2W$, where

$$U=uu'+a(vw'+v'w)+amww',$$
$$V=uv'+u'v-n(vw'+v'w)-(mn-a)ww',$$
$$W=uw'+u'w+vv'+m(vw'+v'w)+(m^2-n)ww',$$

and where the values of α^3 and α^4 were substituted from (5).

In like manner, we find that the product of the six factors in (2) and (3), to be

$$(U+\alpha V+\alpha^2W)(U+\beta V+\beta^2W)(U+\gamma V+\gamma^2W)\ldots.(6).$$